BEAT
The Behavior Expression Animation Toolkit

Justine Cassell
Hannes Vilhjálmsson
Timothy Bickmore
MIT Media Laboratory

SIGGRAPH 2001
EXPLORE INTERACTION AND DIGITAL IMAGES

BEAT: Text to Embodied Speech

Goal

- Input is a typed script. Output is automatically produced appropriate nonverbal behavior synchronized with speech

Approach

- Analyze the text for certain linguistic features
- Generate nonverbal behavior based on those features, knowledge bases, and research into human conversational behavior
- Compile the behaviors and schedule them to be animated in synchrony with speech

Previous Work:

- Automatic lip synchronization (Waters, 1994)
- Talking heads (Nagao & Takeuchi, 1994)
- Automatic animation of comics from text (Kurlander et al., 1996)
- Behavior scripting for interaction behaviors (Perlin & Goldberg, 1996)
- Expressive qualities of human gestures (Chi et al. 2000)
- Embodied Conversational Agents (Rickel & Johnson, Lester, André & Rist)

Embodied Conversational Agents

- Animated humanoid agents which integrate speech and synchronized facial and gestural behaviors.

- Naturalistic procedural animation of face-to-face conversation — among characters, or between characters and humans.

Our Previous ECAs:
Cognitive Representation to Nonverbal Behavior

Examples:

- Animated Conversation (SIGGRAPH ’94)
- REA (CHI ’99)

Design Goals of BEAT

Support range of users and architectures

Extensibility & modularity for

- Variety of real-time and off-line animation systems
- Event-based or scheduled animation
- TTS or recorded audio
- Addition of new nonverbal behaviors and theories of face-to-face conversation
- Porting to new applications & domains

Authorial control

- Give animators ability to augment and override BEAT's choices

Design Features

XML pipeline architecture

- supports extensibility and modularity
- many extensions can be made in XSLT

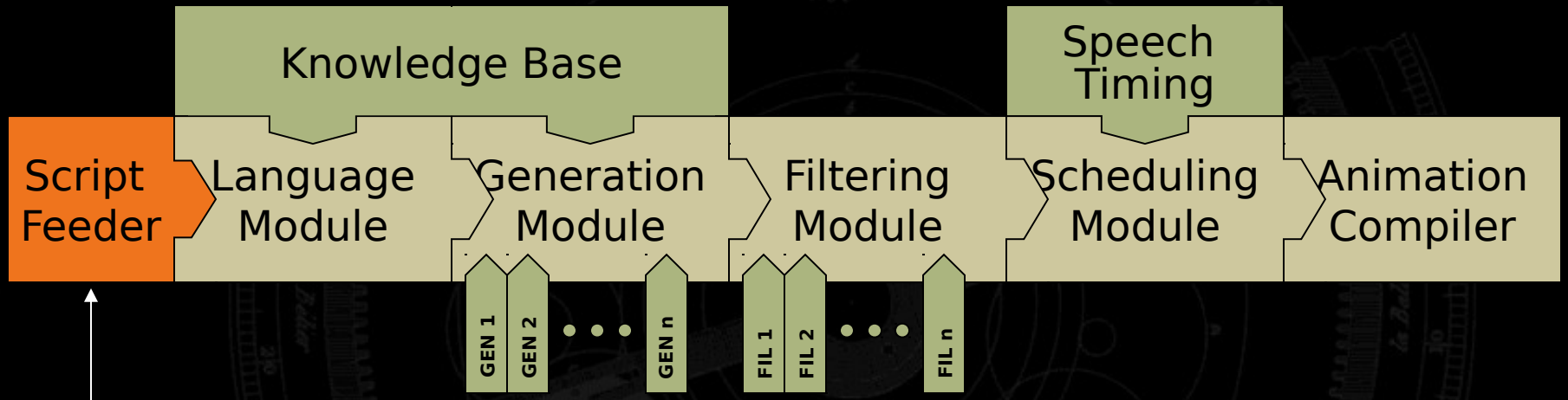
Separation of *generation* and *filtering* of nonverbal behaviors

- provides greater range of possible character behavior and allows multiple generation algorithms to be integrated

Implemented in Java

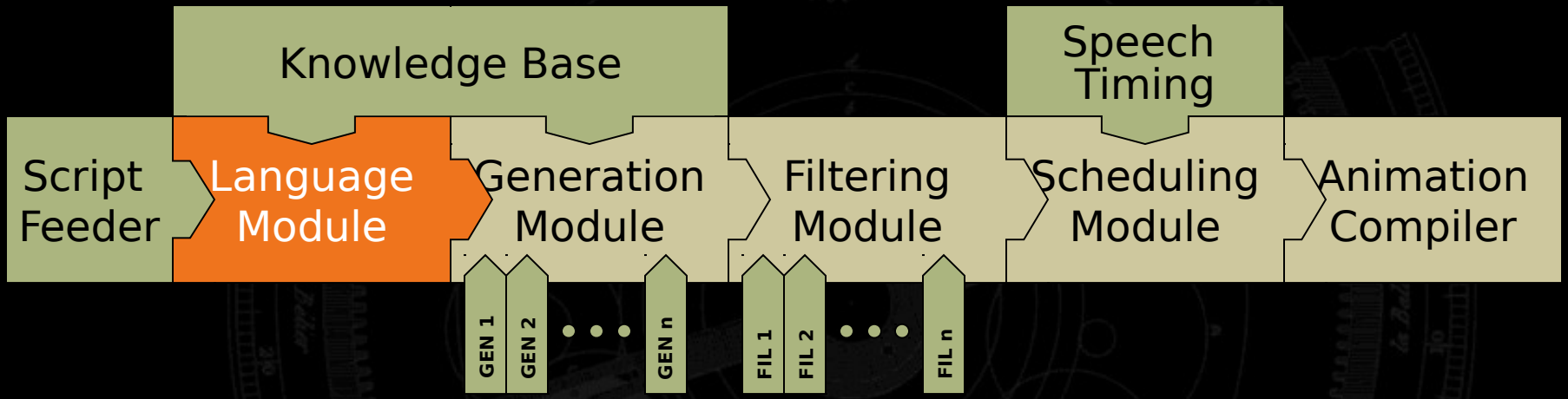
- supports portability

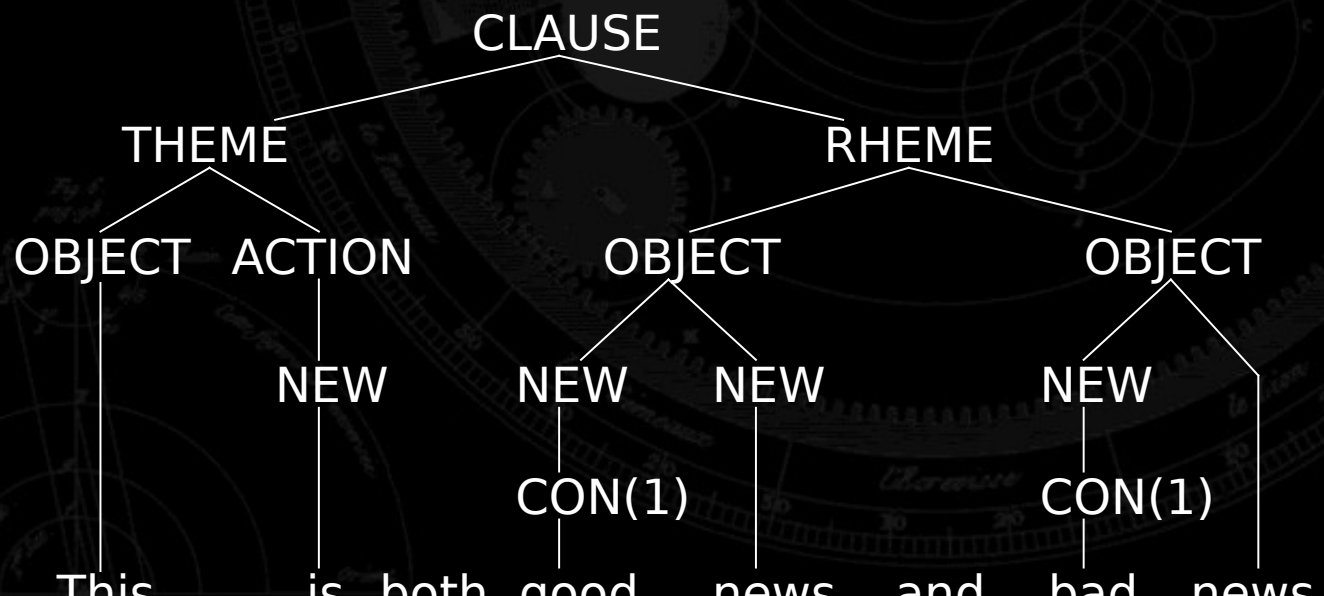
Processing: Script Input



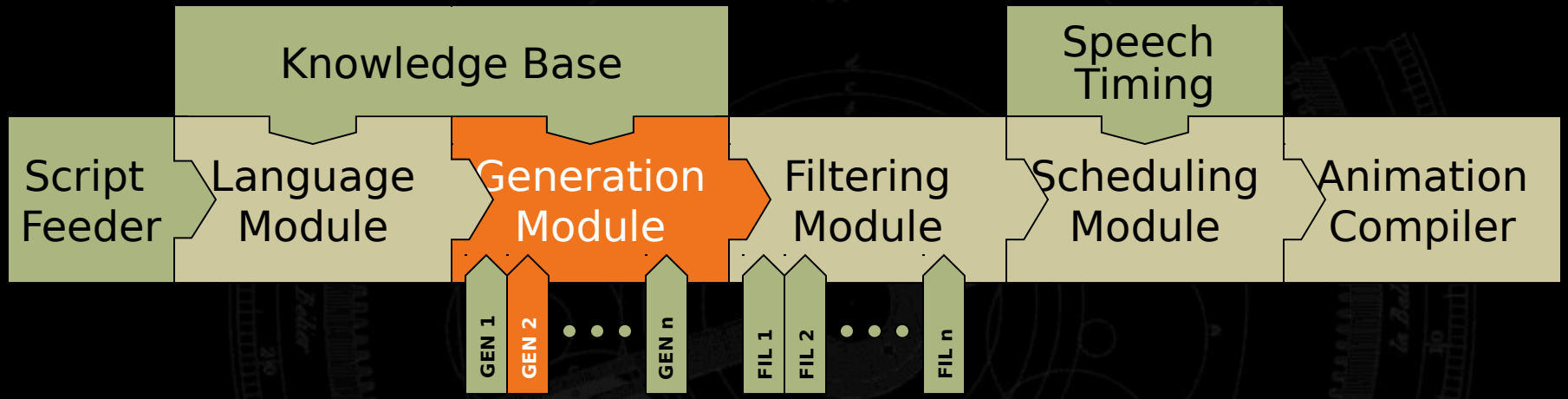
"This is both good news and bad news"

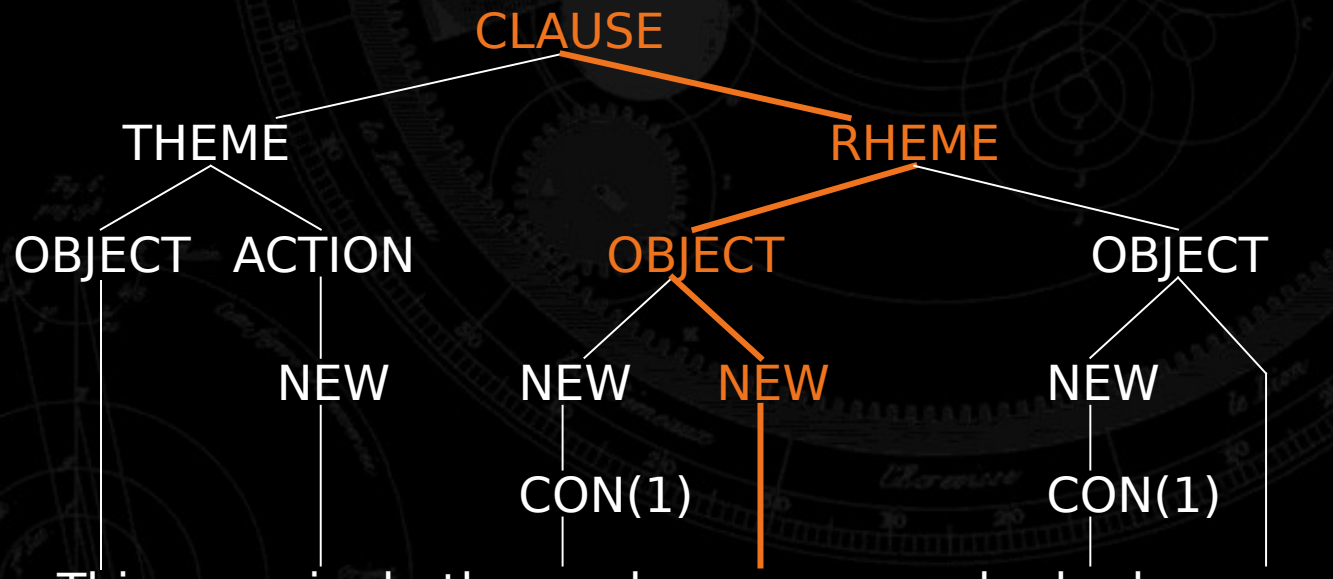
Processing: Language Tagging



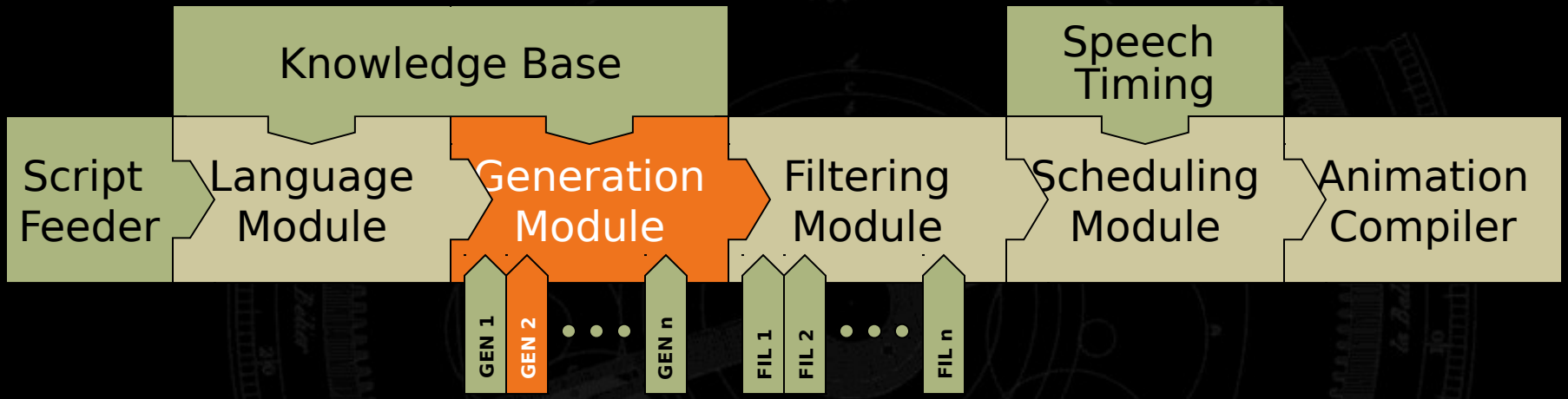


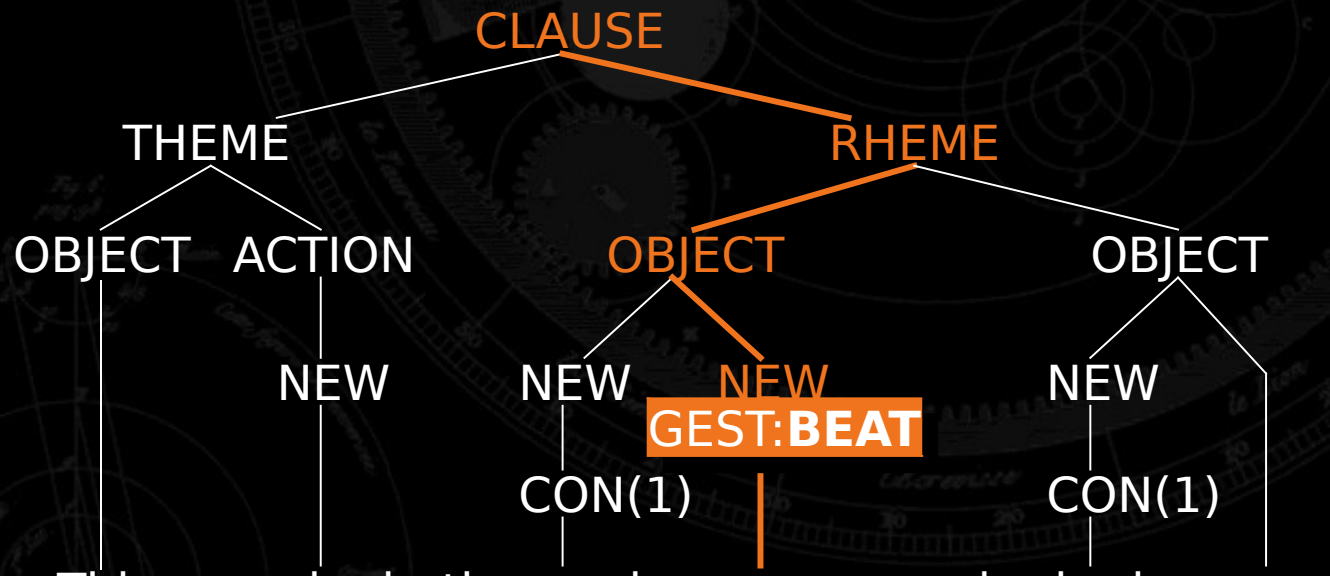
Processing: Behavior Generation



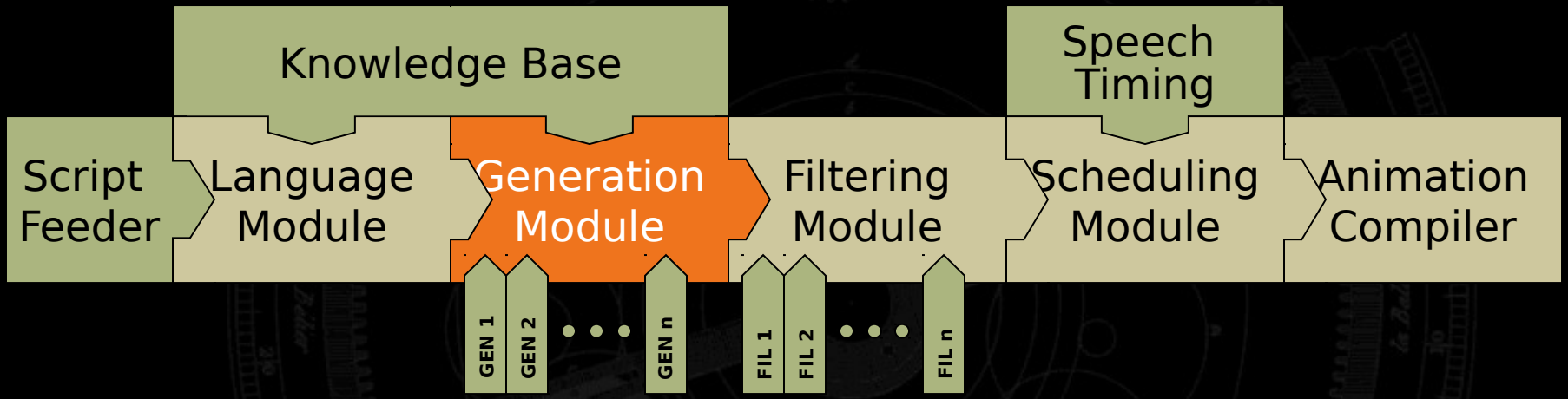


Processing: Behavior Generation

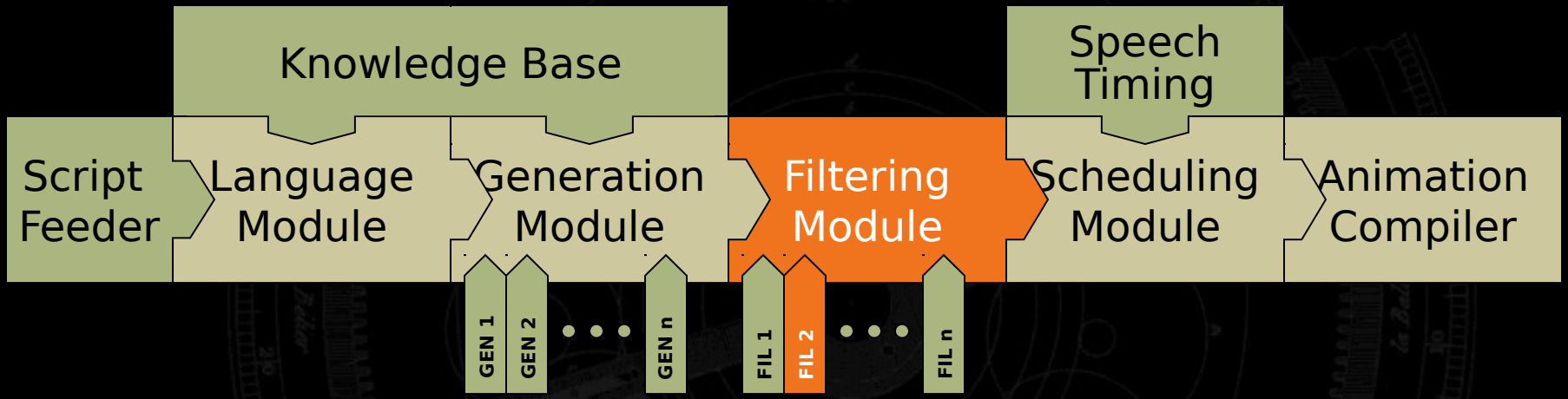




Processing: Behavior Generation



Processing: Behavior Filtering



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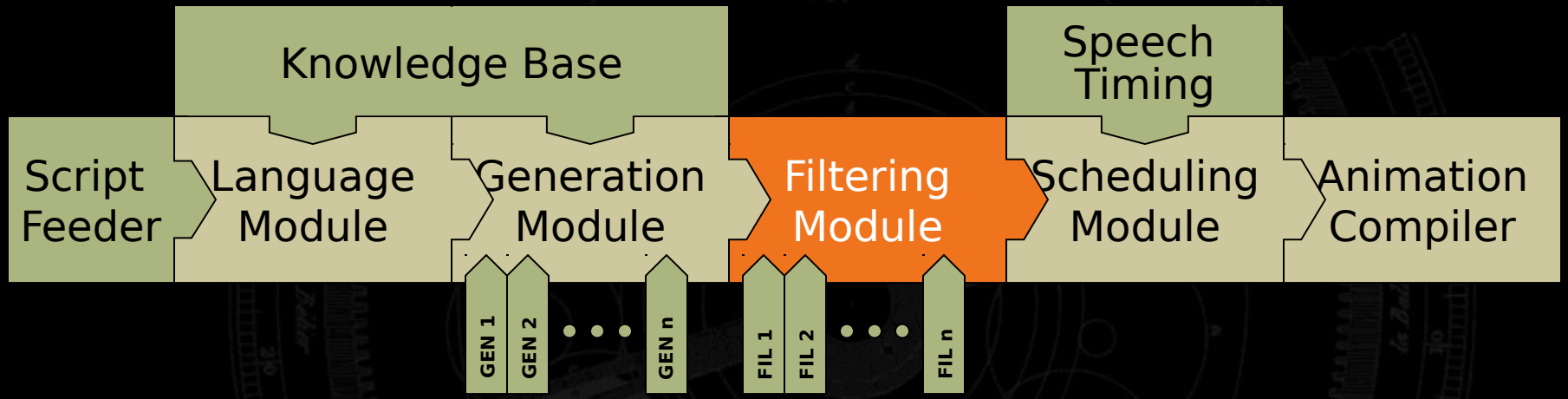
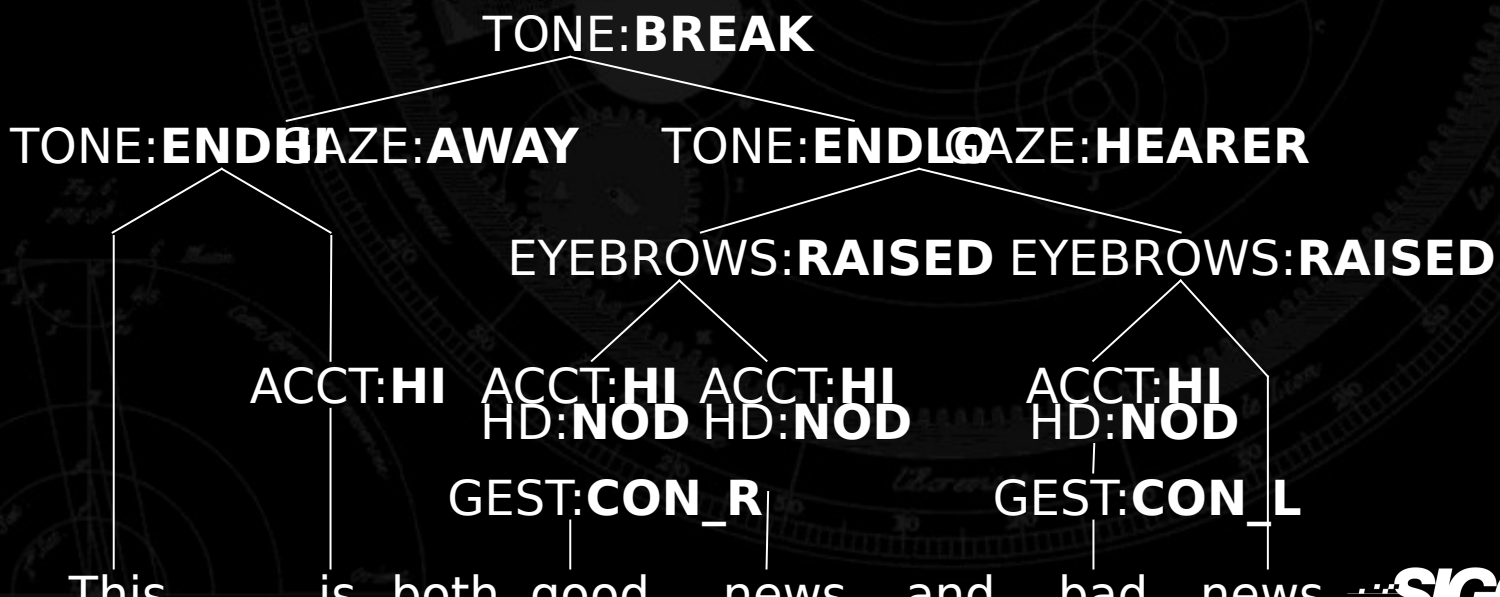
Processing: Behavior Filtering





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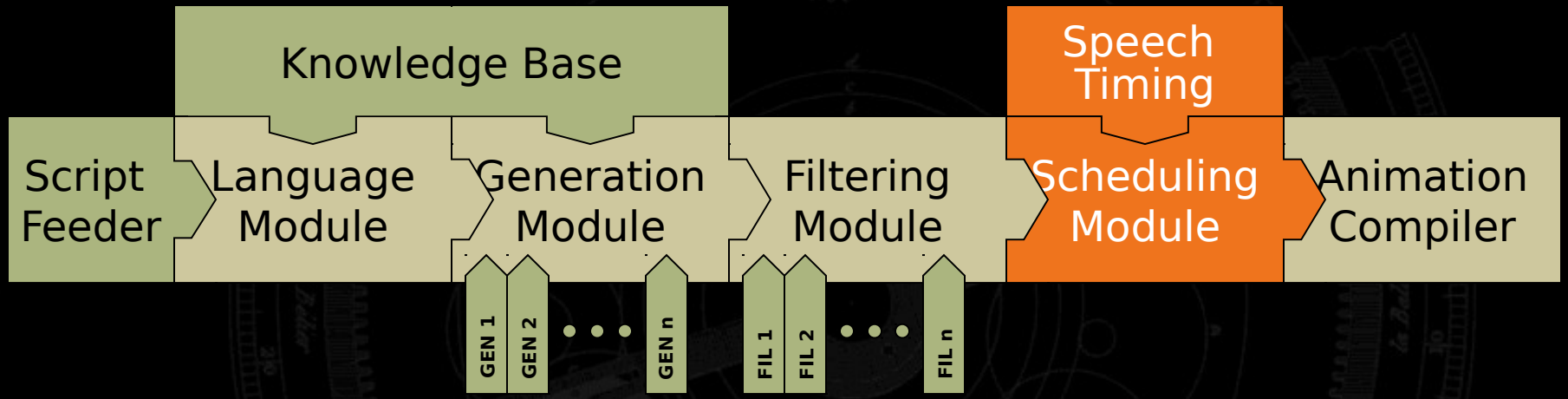
Processing: Behavior Scheduling



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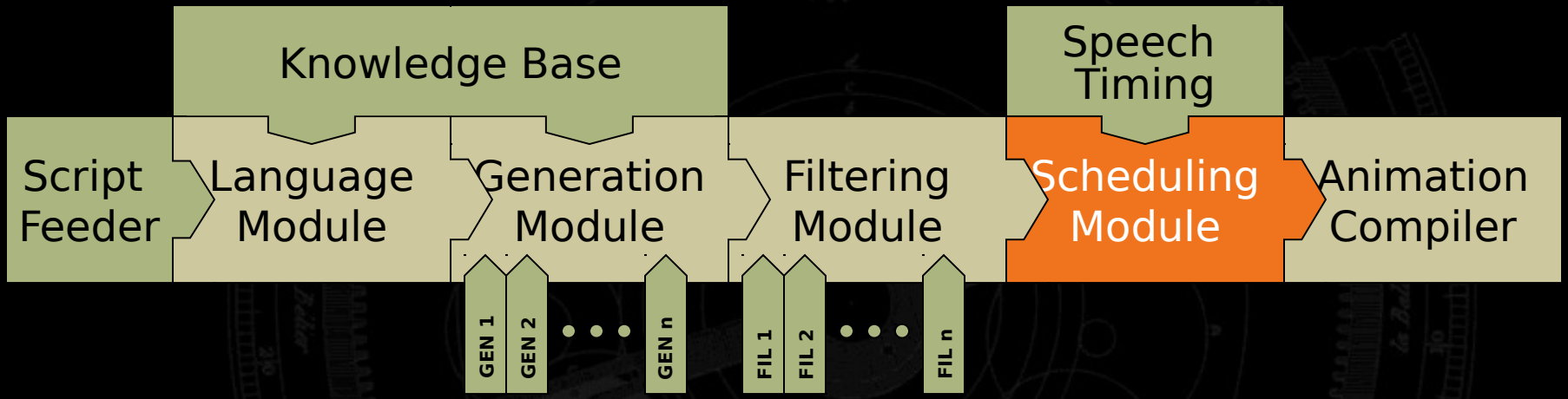
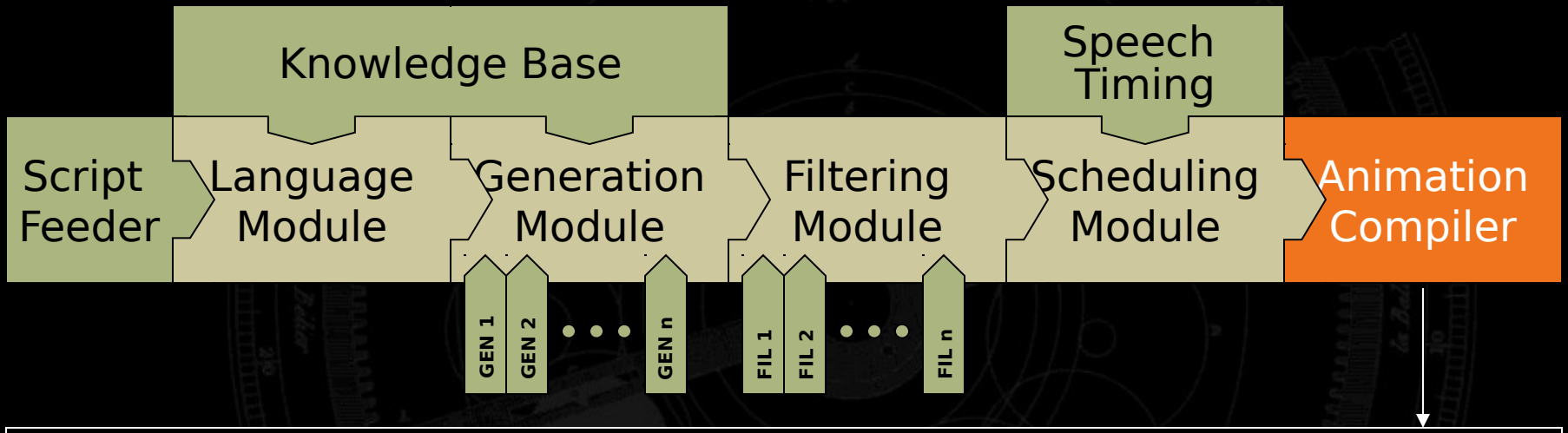
Processing: Behavior Scheduling



Processing: Animation Compilation




```
<AnimationScript SPEAKER="AGENT" HEARER="USER">
<START SPEECH="This is both good news and bad news“>
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<START ACTION="VISEME" TYPE="B" SRT="0.0">
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<START ACTION="VISEME" TYPE="A" SRT="0.511">
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RIGHT_HANDSHAPE="CONTRAST" SRT="0.801">
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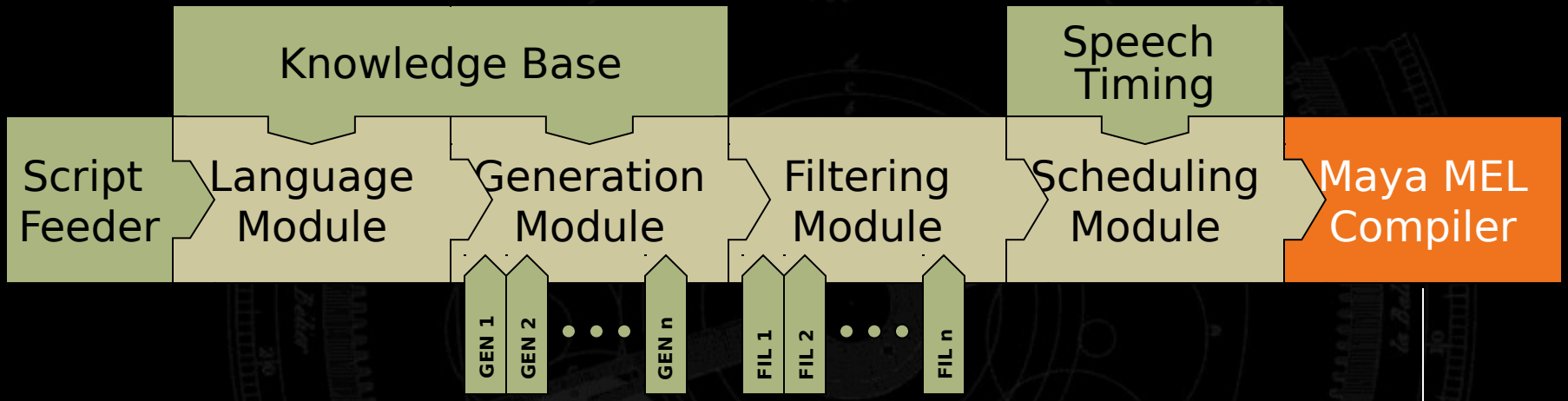
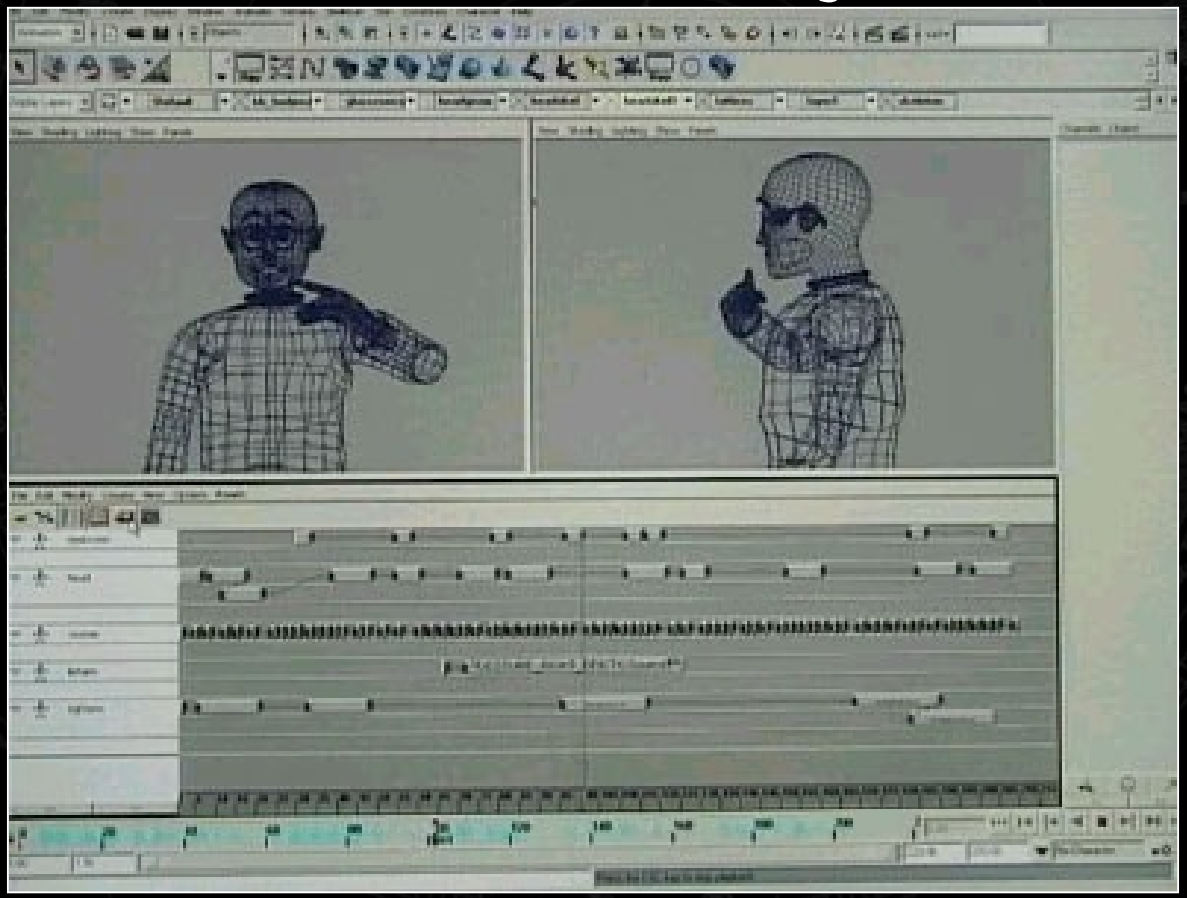
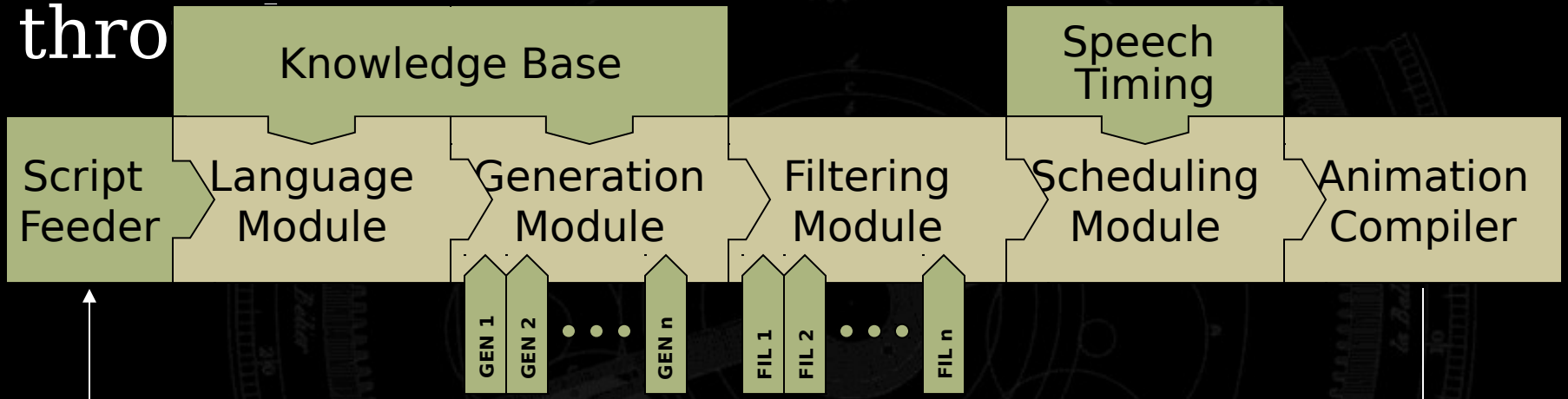
Example: Maya Compilation



Video:
Real-Time Control of Maya



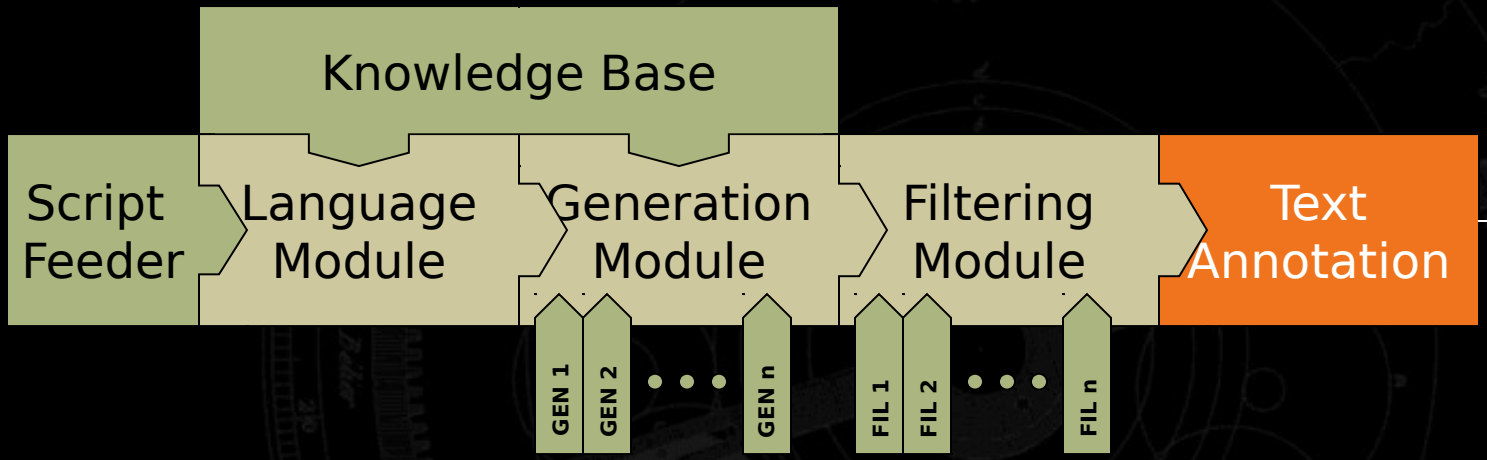
Additional Feature: Tag pass-thro



"This is both <smile> good news </smile>" and bad

```
<AnimationScript SPEAKER="AGENT" HEARER="USER">
<START SPEECH="This is both good news and bad news“>
<START ACTION="GAZE" DIRECTION="AWAY_FROM_HEARER" SRT="0.0">
…
<START ACTION="VISEME" TYPE="B" SRT="0.801">
<START ACTION=“SMILE” SRT=“0.801”>
<START ACTION="GAZE" DIRECTION="TOWARDS_HEARER" SRT="0.801">
<START ACTION="EYEBROWS" SRT="0.901">
…
<STOP ACTION=“SMILE” SRT=“1.5”>
```

Example: Animator Instructions



"You just need [$_1$ to *type in] { a [$_2$ *line] ~~like~~ }"

[1] ICONIC - Typing action
[2] BEAT - Emphasis

* Pitch accent
{} Raised eyebrows
. . Gaze away
__ Gaze towards

Video:
Animation from BEAT-annotated text

Future Work

BEAT is a flexible platform for procedural character animation of nonverbal conversational behaviors synchronized with speech

Future work:

- More complete coverage of conversational behavior
- Extending to multiple characters
- Extending to additional animation systems
- Speed

Currently in use by three other research groups

Acknowledgements

MIT

- Yang Gao, Ian Gouldstone and the other members of GNL

Nearlife

- Dennis Bromley, Geoffrey Beatty, Steve Curcuru, Ryan Kavanaugh

Alias Wavefront

- Jerome Maillot

For more information: gn .www.media.mit.edu/groups/gn/

Other configurations: